Scavenging behaviour in the Nose-Horned Viper *Vipera ammodytes* (Linnaeus 1758)

Diet plays an important role in all aspects of snake life history such as growth rate, survival rate, reproduction and activity patterns (Luiselli et al. 1996, Naulleau & Bonnet 1996, Shine & Madsen 1997, Madsen & Shine 2000, Lourdais et al. 2002). Examination of diet composition is important for numerous reasons such as for understanding the flow of matter and energy in an ecosystem, as well as for the conservation of the species (Maritz et al. 2016). Studies in vivo are one of the widely used methods for analysing snake diet, both by natural observations, or caused defecation or regurgitation of snake's food after the snakes are captured. For secretive animals such as snakes, analysis of their diet is a big challenge, and due to their lifestyle and infrequent feeding, it usually requires many years of field research. Dissection of museum specimens is another common method for assessing dietary preferences of reptiles (Glaudas et al. 2017). Both of these methods have drawbacks (Luiselli & Amori 2016). By examining the stomach contents from museum specimens, it cannot be verified whether digested material comes from freshly killed prey or a carcass (Devault & Krochmal 2002). The stomach contents are rarely in good condition, making it difficult to examine information such as prey size, ingestion and digestion time. Duration of swallowing and digestion, as well as prey type can greatly affect the behaviour of snakes; e.g. longer duration of swallowing and large prey size in the abdomen reduce locomotive abilities and snakes might easily become prey themselves, or be roadkilled (Siers et al. 2018).

It is almost impossible to gather comprehensive information about the diet and hunting methods of predator species by only conducting a series of field studies. If the species is predominantly diurnal, its nocturnal activities are usually accidentally observed; if the species is sedentary and an ambush predator, its mobility and potential other hunting strategies are hard to record. For a comprehensive analysis on feeding behaviour, it is necessary to monitor individuals in the wild for 24 hours via video cameras (Clark 2006, Clark et al. 2012).

Snake species' foraging strategy lie along a continuum of tactics, but most species are sit-and-wait or actively foraging predators (Huey & Pianka 1981, Cundall & Greene 2000, Glaudas et al. 2019). Active foraging is more energy-demanding, but also results in capturing more prey per unit of time. Many snake species accept dead prey in captivity (e.g., Rossi 1992). Scavenging behaviour, as an opportunistic feeding strategy, has also been observed in several snake species, however there are few studies on snake scavenging, making this form of feeding quite neglected (Devault & Krochmal 2002).

In this work, we present an observation on scavenging behaviour of the Nose-horned Viper *Vipera ammodytes* (Linnaeus 1758).

We were monitoring the effects of traffic on the populations of amphibians and reptiles on the road in the canyon of Derventa river in the National park of Tara in Serbia (N 43.956734, E 19.355375). We surveyed the road for animal roadkills on foot, in July 2019.

On 29 July 2019, around 17:30, we found a freshly roadkilled subadult individual *Vipera ammodytes* (around 35 cm of total body length) (Fig. 1 A). Since we needed to check that side of the road on return, we left it on the site of observation. On return, around 20:30, we saw another subadult individual *V. ammodytes* (around 45 cm of total body length) eating this roadkilled individual (Fig. 1 B). We observed the viper without disturbing it. *V. ammodytes* swallowed the other half of its prey in about 10 minutes, after that it left the road.

The prey spectrum of *Vipera ammodytes* consists of lizards and rodents, and occasionally birds, centipedes, snakes and frogs (Clark 1967, Beškov 1977, Beshkov & Dushkov 1981, Biella 1983, Luiselli 1996, Arsovski et al. 2014, Laing 2020). This medium-sized venomous snake is a sit-and-wait predator, with a small home range (Kreiner 2007, Plasinger et al. 2014, Dyugmedzhiev et al. 2020) and scavenging be-

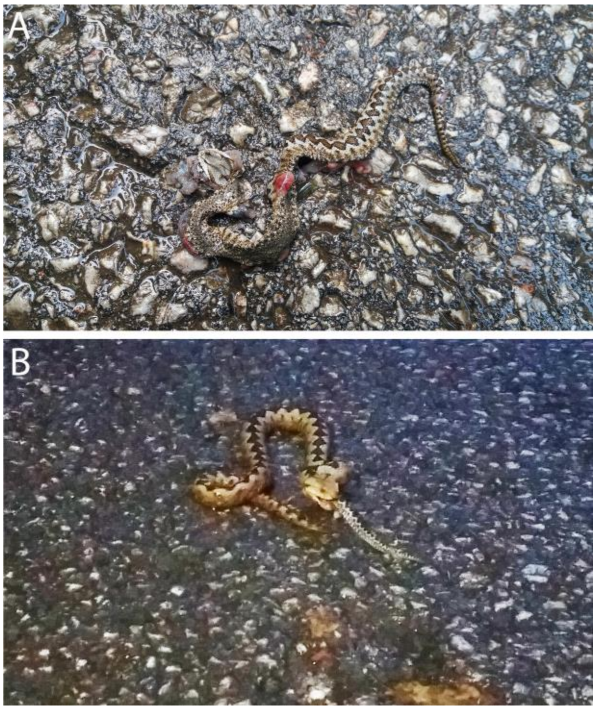

Figure 1. Roadkilled individual *Vipera ammodytes* (A) and scavenging behaviour of another individual of the species (B).

haviour in this species has not been previously reported.

According to the theory of optimal foraging (MacArthur & Pianka 1966), a predator will select prey when the profits of eating it exceed the costs (Pyke et al. 1977). Nutrition theory predicts that individuals will eat the most abundant prey or one that requires less energy to swallow or digest (Schoener 1971, Capizzi et al. 1995). Carcasses are good and easily accessible food for many animals, including snakes (review in Devault & Krochmal 2002). In this case, the Nose-horned Viper was probably attracted by carcass smell. Another explanation may be the fact that at this locality *Vipera ammodytes* often cross the road (several live or dead individuals have been observed), although it is a sit-and-wait predator. It is known that chemical cues are important for scavenging behaviour in snakes, notably in the groups Natricinae and Viperidae, which rely heavily on chemical signals in prey detection (Shivik et al. 2000, Devault & Krochmal 2002). It is a particularly interesting fact that Nose-horned Viper scavanges a conspecific individual, although cannibalism has been reported in this species (Beshkov & Dushkov 1981), but this viper did not kill its prey. The observed scavenging behaviour of the Nose-horned Viper, may indicate that it is an opportunistic predator that eats carcasses and does not hunt only from ambush.

Further more intensive studies are needed to prove whether the recorded case of scavenging was a coincidence or a common behaviour at this locality, since on this part of the road we found many roadkilled lizards (*Podarcis muralis* (Laurenti 1768), *Lacerta viridis* (Laurenti 1768)), snakes (*Zamenis longissimus* (Laurenti 1768) and *V. ammodytes*)) and amphibians (*Rana temporaria* (Linnaeus 1758), *Bufo bufo* (Linnaeus 1758), *Bombina variegata* (Linnaeus 1758) and *Salamandra salamandra* (Linnaeus 1758)).

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Marko ANĐELKOVIĆ[1,*], Sara STANKOVIĆ[2] and Jana MASLOVARIĆ[2]

1. University of Belgrade, Institute for Biological Research "Siniša Stanković" – National Institute of Republic of Serbia, Department of Evolutionary Biology, Despota Stefana Blvd. 142, 11000 Belgrade, Serbia.
2. University of Belgrade, Faculty of Biology, Institute of Zoology, Studentski trg 16, 11000 Belgrade, Serbia.

* Corresponding author, M. Anđelković,
E-mail: marko.andjelkovic@ibiss.bg.ac.rs